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ABSTRACT

This study focused on the way mathematics was taught in selected primary school classrooms. The study involved the observation of 21 fourth-grade classes in eight schools over a two-week period. Results indicated a hiatus between what was taught and what should be taught and between how mathematics is taught and how it should be taught. Researchers felt that teachers were not familiar with either the aims or the content of the curriculum. They further suggested that it was evident that some teachers were neither confident with nor competent in the subject matter. Findings indicate that teachers had scant knowledge of the components of the learning process; few, for example, knew about the importance of such things as sequencing of subject matter, mastery of prerequisite skills, or questioning techniques. There was little evidence that teachers accepted: (1) the essential nature of concrete aids in concept development; (2) that language is an integral part of learning mathematics; (3) that learning is more likely to be retained if it is related to practical situations; and (4) that children learn at different rates and use different methods to learn. The need for improved in-service and pre-service training is discussed. (PK)

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MT. DRUITT LONGITUDINAL STUDY

SCHOOL OF EDUCATION MACQUARIE UNIVERSITY, NORTH RYDE, AUSTRALIA 2113

"That's the only maths today"
"Yahoo! You beauty!"

Qualitative observation of
Grade 4 mathematics classes.

Peter O'Brien and Arthur Richardson
June, 1987

SE 048 614

OPY AVAILABLE

INTRODUCTION

In an address to the annual meeting of the National Council of Teachers of Mathematics (N.C.T.M.) in Boston, Bauersfeld (1980) pointed out that the teaching and learning of mathematics is achieved by a process of "human interaction" between and across students and teachers. Bishop (1980) also described the teaching of mathematics as a "social process", one which involves both the development of the student, in terms of problem solving strategies, and the teacher, in terms of the management of specific classroom situations. However, with the exception of Sanger (1986) who studied aspects of student and teacher behaviour in a post-secondary computer theory course, there have been no descriptions of the social process of, no reports of qualitative research specifically into, the teaching of mathematics in school classrooms reported in the journals during the last ten years. Instead the accepted practice, as Carpenter (1980 : 353) indicates, is that "rather than beginning with a careful observation of children learning mathematics, research has too often begun with narrowly defined hypotheses, tested in carefully controlled settings, using standardised, objective instrumentation". It is in the light of this situation that this ethnographic study into the way mathematics is taught in primary school classrooms and the actions and reactions of pupils and teachers during mathematics lessons, is reported.

Only one study of a qualitative nature, dealing in any way with the teaching of mathematics in schools is to be found. It is a report by Delamont (in Galton and Willcocks, 1983) of the observation of the curriculum, teachers and pupils in the first year of secondary school and formed one part of the Observational Research and Classroom

Learning Evaluation Project (ORACLE) which ran from 1975 to 1980. This study, working within a conceptual framework of "high-inference issues" reports that the "overwhelming impression observers received was that the school had rules about all aspects of their organisations; about use of time, space and objects, and about authority "(Delamont, 1983 : 120). This general conclusion typifies the study in that ORACLE dealt with the overall position of the student, teacher and curriculum without looking at specific subject-matter content and the way it was taught.

The study reported here, however, focuses deliberately on the way mathematics was taught in the primary school classrooms observed.

When an ethnographic (qualitative, descriptive) study of classroom situations is undertaken there is a large body of information amassed. Miles and Huberman (1984) advocate the processes of "focusing" and "bounding" as a means of reducing the data to facilitate the addressing of research questions within a conceptual framework. That framework within this report is based both on the curriculum for primary school mathematics in the State of New South Wales (Australia) and on recent developments within N.S.W primary school curricula. Such developments stem mainly from the Cockcroft Report into the Teaching of Mathematics in Schools (1982). Observations reported here have been focussed on the extent to which the aims of the N.S.W. mathematics curriculum are being satisfied and the extent to which current thought in primary school mathematics education is reflected in the activities within the classrooms.

Mathematics in N.S.W. Primary Schools.

The broad aims of the Curriculum for N.S.W. Primary School Mathematics (1972 Revision) are as follows:

1. to assist the child to understand and interpret his environment;
2. to satisfy the present mathematical needs of the child;
3. to lay a sound foundation for future mathematical studies;
4. to create favourable attitudes towards, and to stimulate interest in, mathematics;
5. to develop - understanding of fundamental ideas of numbers, measurement and shapes;
   - knowledge of language and relationships;
   - skill in computations and problem solving.

These aims are to be achieved through the provision of opportunities to: - explore, discover, describe and record relationships;

- create patterns and make statements about the relationships contained in them.

The aims were modified slightly at a Directorate of Studies Conference in 1979 which made recommendations relating to:

1. greater emphasis being placed on establishing more effective learning situations;
2. greater emphasis being placed on uses and applications in the child's environment;
3. the importance of learner-oriented materials;
4. balancing the psychological, societal and mathematical factors which contribute to a mathematics curriculum.

Further specific content modifications occurred in 1980, namely:

1. in fraction operations : only denominators of 2,4,5,10,20 and 100 would be used;

   :division of fractions where the divisor or dividend are not whole numbers would be deleted (eg. 1/2 ÷ 2/5, 2 1/2 ÷ 3 1/4);

2. in long division : divisors with three places (excluding multiples of 100) will be for the advanced child only;
3. the cessation of the formal treatment of sets.

There exist two more recent developments in primary mathematics which are having an impact on the teaching of mathematics in N.S.W. First there is the Western Australia State Department of Education Activity Based Mathematics Syllabus which has the following features:

1. number work is to be practical and based on concrete experience to suit the child's way of learning;
2. a reduction in the use of expanded notation and lengthy methods of setting out computations;
3. the introduction, at a later level, of operations with fractions.

Second, many of the recommendations of the Cockcroft Report (1982) are forming the bases for the development of a new mathematics curricular for N.S.W. primary schools which is due to be released in 1988. The Cockcroft Report (1982 : 84) states that:

> primary school mathematics should enrich children's aesthetic and linguistic experience, provide them with the means of exploring their environment and develop

their powers of logical thought in addition to equipping them with the numerical skills which will be a powerful tool for later work and study.

It is suggested by the Report that these objectives could be met through carefully structured work which is always followed up, thereby leading to the establishment of concepts and of links with other work. Other claims are made. Emphasis should be placed on exploring the answers and questions of the students. Prior to having students address questions in written form great value should be placed on oral work which will be a necessary prerequisite for many students in their solving of problems. No attempt should be made to force specific methods or solutions onto students but rather they should be encouraged to use the method which suits them best (whatever that means!). It is worth noting that the extensive Survey of Primary Education in England (1978) concluded that the children's learning to operate with numbers may need to be more closely linked with their learning to use them in a variety of situations. The Report notes that the extensive, time-consuming efforts made to teach children to calculate are not matched by high scores in problems associated with everyday situations.

Criticisms have been made of the absence of provision for the less and more able students in the N.S.W. mathematics curriculum (N.S.W. Dept. of Education, 1979). The Cockcroft Report (1982 : 97) declares that more able students need to be extended through challenging, horizontal extension work rather then being left to repetitious tasks already mastered. For the less able, the Report suggests (1982 : 98) that it is vital that teachers take time to

diagnose factors related to low achievement. For these students emphasis must be placed on their mastery of prerequisite knowledge if the compounding of their failure is to be prevented.

A question remains, though, as to whether such recommendations need to be, or should be, generalised to mathematics education in N.S.W. Little, apart from anecdote, is known about the way maths is taught in N.S.W. primary schools. It may be the case that children do use "best methods" in solving "everyday" problems. It may be that mastery strategies are being implemented. What is clear, however, is the vital necessity to establish sound knowledge of the actuality of mathematics education. The study and findings reported here are meant to motivate discussion, giving a basis in objective descriptions.

THE STUDY

The study involved the observation of twenty-one fourth grade classes in eight schools over a period of two weeks in 1982. The observations occurred over four days, three of which were consecutive and performed by one observer, whilst a second observer visited the class on another day not in the same week as the first. The observations were conducted from the commencement of the school day until the lunch break, a period of three to four hours. The volunteer teachers were advised that observation of their "normal" teaching situations for basic skills was desired, with as few interruptions (choir practice, scripture, etc.) as possible. As well, the teachers were advised that the observation was not related to individual teacher evaluation and any reporting would be done in such a way as to guarantee the teachers' anonymity.

The major criticisms of qualitative research centre on the aspects of the reliability and the validity of the findings. With respect to this study the reliability and validity are enhanced by virtue of the facts that;

1. the schools in which the observations took place had been participating in the Mt. Druitt Longitudinal Study (O'Brien, 1981). Whilst the Study, per se, is not relevant to this paper, the fact that the teachers and students were familiar with the observers, through the on-going operation of the Study, is relevant. This familiarity led to the acceptance, by the students and teachers, of the presence of the observers in the classrooms which, in turn, led to a minimisation of the effect of the observers on the classroom operations;
2. the observation of each class was carried out by two observers who would meet with teachers after lessons to discuss matters that may have arisen in the observation and which needed clarification before reporting;
3. observers had been trained in the previous year in a systematic, quantitative observation system; training for the qualitative observation reported here included common reading, discussion and trial ethnographic classroom observation, singly and in pairs;
4. the observers determined, prior to the observations, a number of categories for classroom descriptions which became the common focus for the observers.

These categories, or "critical incidents", were developed following preliminary, trial observations and included:

1. teacher verbal presentation of incorrect/misleading factual information;
2. unclear or incomplete instructions;
3. lack of prerequisite knowledge on child's part;
4. behaviour/attention to task of students;
5. incorrect responses left uncorrected or reinforced/correct responses punished;
6. implications of individual teachers' theory of learning;
7. teacher's classroom management;
8. cognitive challenge of classroom tasks.

These categories were not meant to limit the observation nor did they.

The observation produced lengthy, hand written descriptions of classroom activities. Mathematics was operationally defined by the teachers observed who nominated clearly that it was "now mathematics" or that the students "do these sums" or signified Maths in some related variations on such introductions. Mathematics was observed to take up 26% of all observations. This compared to 43% of observations taken up by English language activities.

OBSERVATIONS

1. Content.

a. Mentals

The most common method of commencing the mathematics segment of observed "lessons" was by using a phrase such as: "Write down, answers

only, to these questions in three minutes". The so-called "mentals" involved the teacher's giving from ten to twenty questions which were usually written on the blackboard. Following the childrens' attempts to comply, answers were then given usually by the teacher who would then typically say: "Hands up those who had them all right." As the practice of "mentals" was extensive, discussion of this phenomenon within primary mathematics classes is in order. The Cockcroft Report (1982 : 75) remarks that "mentals" in the sense of the example above were, happily, occupying a far less prominent position in most mathematics teaching. The Report goes on to say that the reason for this is the realisation of the fact that, "for the mathematically able they could be seen as a source of enjoyment and challenge but for those whose mathematical ability was limited they were much more likely to lead to increasing loss of confidence, increasing antipathy to mathematics and sometimes even to feelings of humiliation".

With the exception of one teacher, who analysed the errors made in the "mentals" by asking students to explain how they arrived at their answers and who graphed individual student's progress from day to day, the teachers observed appeared not to be interested in knowing who made what, and how many, errors. No follow-up work or remediation was attempted.

The following two illustrations emphasise the arbitrariness of the use of "mentals". In one class the teacher recorded the marks of students from a "mentals" exercise constructed by a student. In a second class, students were given three minutes to answer the "mentals" but it was not until fourteen minutes later that they finished.

The issues, raised by the common practice of "mentals", of meaningfulness, reliability of assessment, unrealistic expectations, non-attention to mastery of items and non-attention to individual's responses are important and suggest that the use of "mentals" is not an effective teaching strategy and that the negative aspects reported in the Cockcroft Report may be being perpetuated in these N.S.W. classrooms. Mental arithmetic, however, can be used to good effect in teaching mathematics for the following reasons:

1. it can allow students to have free rein in obtaining solutions rather than forcing them into using the method of solution;
2. mental and oral work is particularly important for young children who should not have to progress into written work too early;
3. it can promote speed and confidence in working with basic facts;
4. it can promote discussion, especially in relation to generic skills in problem solving;
5. it can be a means of informally introducing concepts;
6. if students, within a class, are grouped by ability then mentals can become a stimulus for a targeted group.

However, in all the description generated there is not one incident which illustrates any of those desired effects.

b. Multiplication Tables

The majority of lessons involved, in some way, the revision of "times tables". This took the form of competitions within the class which were either teacher or student run; races against time; recitation whilst performing a physical task; or random questioning around the class. Most of these activities resulted in enjoyment to judge by the students who were usually all fully involved. However,

there were cases where students were not able to recite the appropriate table fact(s) and yet the activity finished without any attempts at remediation or follow-up. For example,

Teacher: (asks Christine, a chronic non-participant) "What is 6 times 1?"

Christine: (after a very long pause) "6"

Teacher: "Good, you're learning"

Teacher then changes activity.

c. Introduction of New Concepts

Of the classes in which new concepts were introduced, the most common methods were teacher-led discussion and guided discovery using concrete aids and/or written material. There were instances of successful introductions which had high levels of student participation and interaction whilst others gave the impression that they were not well-planned.

Consider the following contrasting examples:

Case 1. The teacher hands out a stencil which is read silently by all and then aloud by one student. The students are asked to carefully analyse the problem and to suggest methods of solving it. The teacher asks questions, pertaining to the problem, of every student and together they develop a strategy for solving the problem. All students are on task. Then followed a mixed set of questions to prevent overgeneralisation of the new but related concept. A set of questions was then given to reinforce the new concept.

Case 2. The teacher hands out a stencil and asks students to read it. Many students raise hands to ask questions about the sheet because of its apparent imprecision of expression. Other students

engage in calling out to attract the teacher's attention to their questions. The asking and answering of these clarifying questions takes more time than would have been anticipated and results in off-task behaviour by several students. This situation may have been avoided if the stencil had been clear and precise.

In another case of introducing a new concept an example on inconsistency and inflexibility on the teacher's part occurred:

The teacher introduced division with remainder using centicubes. For example, 22 ÷ 3. The teacher-suggested strategy was to divide the centicubes into groups of 3 and "see what the remainder is". Capable students, who were able to "see" the answer were criticised for not using the centicubes. The teacher then followed this criticism by telling the class that: "the next question is to be worked out in your heads".

With such contradictory behaviour it would not be surprising to witness negative feelings on the part of the students. What was surprising was the docile reaction of the students to this inconsistency. Perhaps they have become inured to this type of behaviour from the teacher.

d. Linkages

That many topics dealt with in mathematics are related is fact. However, whether primary school students are aware of the connections depends largely on the teacher constantly undertaking discussion within the class to establish these relationships. In the classrooms observed there were no attempts to relate subject matter to previously learnt work.

Existing concurrently with the need to link topics within mathematics is the need to establish whether previously taught material has been mastered if the concepts involved are required in any new work. There appeared to be no systematic monitoring of the existence of prerequisite skills in those classes where new work was being introduced. The teacher may have perceived the giving of "mentals" as performing this function, however, as reported above, in the great majority of cases, no attempts were made to interpret the results of mentals. If it were in the teacher's mind that mentals would "jog" the memory of the students, it is still necessary to ascertain the extent to which the memory has been jogged and where any gaps in prerequisite skills lie. In attending to the mastery of prerequisite skills the teacher may reduce the occurrences of statements such as "Oh, sir, I [still] can't do them".

e. Everyday Environment

The Curriculum for N.S.W. Primary Schools Mathematics (1972 Revised : 3) lists the major outcomes of teaching mathematics as being understanding, knowledge and the attainment of skills. This is to be achieved through providing activities which will allow the students to experience the role that mathematics plays in their environment. Of the lessons observed, few examples of relating mathematics to the child's environment were noted. Of the few that occurred, some were not at all realistic whilst others failed to fully utilise the experiences of the child. One such example is the case of the introduction of the concepts of vertical and horizontal lines and of right angles. The teacher demonstrated, on the board, examples (but no non-examples) of vertical and horizontal lines and then asked for

examples from the environment. After many examples were given by the enthusiastic class the teacher instructed the class to copy down the definitions, of horizontal and vertical lines, which she wrote on the board. She then added, without any discussion, the definition of a "right angle" as "the intersections of a horizontal and vertical line" and after the class had copied this down the lesson ended. It is left to the reader to ascertain to what extent the concept of a "right angle" will be retained by the student. [It should be noted that in the following mathematics lesson in this class no reference was made to any of these concepts.]

f. Language Skills

To obtain an overview of the apparent importance teachers placed on various aspects of mathematics an analysis was made of the types of mathematical activity taking place in the classrooms. A tally was made of each type of activity which occurred during the period of observation of the twenty-one classes and is summarised in Table 1.

Table 1

Frequency of Mathematical Activities

Type of Activity	No. of times activity occurred	Activity as % of total activities
Number	51	47
Measurement	8	7
Shapes	6	6
Space	0	0
Graphs	3	3
Development of logical ideas	2	2
Practical work	17	16
Oral work	13*	12
Maths 'games'	8*	7
	108	

*These activities were confined to a small number of classes. For examples, of the eight occurrences of 'Maths games', four came from one class.

It is clear from Table 1 that the teachers observed placed a disproportionate emphasis on numerical work to the detriment of the other aims of the mathematics curriculum in N.S.W primary schools. A further consequence of the amount of time spent on number work was that the development of language skills within the mathematics context

suffered. If there is no opportunity for the exploration, discovery and description of relationships there can be no development of the skills needed to formulate and express mathematical ideas. Furthermore, as the Cockcroft Report (1982 : 90-91) suggests, if alternative words for the same operation, or alternative meanings for the same words are not known, students will have difficulty with both computational questions and the so-called "word" problems. An example of a lost opportunity for discussion came when a teacher, having detected that a student was unable to complete a task, said, "unless you ask, you are in danger of being left behind". The teacher did not attempt to encourage the student concerned to talk about the difficulty, nor did the teacher direct any questions to the student in order that the difficulty might be overcome. Instead the teacher's action, following what can only be described as a stock comment, was to continue walking around the class and to leave the student with his problem unsolved. Despite the shortcomings in the content of the classes observed the observations have produced a major confounding element, namely, that most students for most of the time were actively engaged during the mathematics lessons and that they appeared to obtain a degree of intellectual challenge, interest and satisfaction from the work given to them. The pertinent question to be addressed here is that of the durability of the challenge, interest and satisfaction over the remaining years of the students' schooling. Much will depend on the extent to which teachers develop and implement a carefully structured strategy of teaching which will be learner oriented. There is no doubt, though, that fourth graders in these

rooms engaged continuously in repetitive seat-work. Perhaps this on-task behaviour reinforces teachers and provokes further provision of repetitive seat-work.

2. Teaching and Management Style.

a. Developing favourable attitudes and the use of Reinforcement/ Punishment

One of the most common methods of reinforcement was the practice of awarding points to groups or individuals and summing these points over some time period. This, in the schools observed, had little positive effect on the attitude of the students and in some cases led to aggressive behaviour because of the teachers inconsistencies in awarding the points. Some examples of specific reinforcement and punishment which occurred are:

1. Early finishers were allowed to leave early for recess whilst non-finishers were kept back.
2. Positive reinforcement (points) was given for correct behaviour as opposed to the results of work. In this case the teacher was unaware of the satisfactory mathematical progress of a previously deviant student.
3. Rewards were given to all students at the slightest indication of pleasing work. This resulted in there being none of the aggression that existed in some other classes.
4. Praise was given to students who improved their results from one day to the next as measured by a chart, maintained by the teacher, of the number of correct answers against the number of questions attempted.

5. The statement "Work not done will be finished at recess!" - another punishment for the slower, less-able students?
6. A deliberate attempt to praise the behaviour and work of a recalcitrant led to greater participation, not to mention a smile, on the part of the student.
7. A class was asked to cut out shapes after tracing around their set squares and then to "play with them and see what you can make". Karl made an aeroplane and was chastised because he was "supposed to be making rectangles and squares". The existence of unclear and, in this case, uncommunicated objectives led to both punishment and to feelings of hostility as manifested in Karl's resultant surly behaviour.
8. Two students appeared to be victims of over-management when they were desisted for not having their wooden rods in exactly the position nominated by the teacher. This "punishment" led to sullenness on their part and, eventually, to disturbances of the class.
9. A teacher statement: "Year 3 (part of a composite 3/4 class), since you're so weak in Maths, here is a tables chart."
10. Another teacher, at the end of a briefer than usual mathematics lesson communicated to the students by saying, "that's the only maths today". The students responded by shouting, "Yahoo! You beauty!"

The practice of detaining the slow students so that they completed the allotted tasks would appear to be punishing their failure to achieve. It would be preferable for teachers to determine why these students are not completing the work in the allocated time

and then to adopt strategies to address the situation. This may involve reward/punishment for those who have the ability to fulfil the requirements but who have been consistently off-task. Alternatively, it may involve determining whether the expectations are realistic for some students, or to embark on re-teaching or remediation programmes so that the students have the prerequisite knowledge necessary to successfully complete the given tasks. Clearly, though, it is precisely the students who need to feel attracted by mathematics and to achieve more successfully who receive least encouragement and probably the greatest punishment. Almost without exception the teachers observed had failed to adopt strategies which would encourage positive attitudes.

b. Teaching Styles

The spectrum observed ranged from:

teachers who taught from the chalkboard to those who were itinerant;

teachers who equated noise with no work to those who encouraged peer-group discussion;

classrooms where students sat in regimented rows to classrooms where group work was encouraged by suitable positioning of furniture;

teachers who had successful group work by virtue of the early establishing of routines for, and expectations of, the students behaviour to teachers whose group work appeared to be disorganised and which consequently led to off-task behaviour;

teachers who used ridicule and were rewarded with reticence on the part of the students to teachers who were quick to seize an opportunity to praise;

teachers who set obtainable goals leading to positive attitudes on the part of the student to teachers whose unrealistic expectations led to frustration and off-task behaviour;

teachers who valued the diagnosis of errors as a means of improving performance to those who paid scant attention to student mistakes, thereby magnifying problems at a later date;

teachers who asked interpretative, high level questions and who discussed, at length, the skills needed to solve the problems presented to teachers who introduced concepts with statements such as 'Today we are doing number sentences' and then proceed in a didactic manner to illustrate methods of solution without meaningful discussion. This neglect of oral work prior to the written work was commonplace and added to the impression that mathematics, as it was taught in the classrooms observed, is a repetitive subject. Teachers appeared to believe wholeheartedly in the efficacy of continuous practice. It was not remarkable that a teacher should make a statement such as, 'ah, Johnny, you're far, far away', to a student shortly after beginning a mathematics lesson when little was done to stimulate an interest in the learning of mathematics;

teachers who used infrequent management strategies effectively to those who desisted students frequently thus reducing the effect of the strategy and eventually leading to a negative impact on the class;

If a generalisation were to be made concerning the teaching styles observed it would be that there was a lack of child centred activity, that mathematical enquiry and exploration, when it ocurred, was not directed at the learner, and that the "social process" of mathematics appeared to be being ignored.

c. Teacher error, inconsistency and lack of clarity

Under the assumption that a picture is worth a thousand words, a collection of examples, seen or heard in these rooms, of the teaching of error are cited below. The examples emphasise the need for circumspection on the part of the teacher in the planning and presentation of learning materials. At the same time the examples indicate a lack of confidence and knowledge of the subject matter on the part of the teacher.

1. $10^3 + 800 = 8000$

2. $\begin{array}{r} {\scriptstyle 1\ 1\ 1} \\ 1000 \\ -666 \\ \hline 334 \end{array}$

3. 74 - 36

T : 74 = 7 x 10 + 1 x 4

= 60 + 14

Therefore $\begin{array}{r} 74 \\ -36 \\ \hline 48 \end{array}$

The teacher, in summarising the method, says: "all we've done is

expanded the sum" [and made an error which fortunately was noticed by a student a short time later.]

4. T: "Write 200 less than 1000"

Some students gave as their answer

$200 < 1000$

This response was ultimately accepted by the teacher but was "not what was asked for". The message here is that one gets what one asks for and that questions need to be unambiguous.

5. T: [writes 1/2 x 64 on chalkboard]

: "this is the same as 1/2 of 64."

: [writes 1/2 x 38 on chalkboard and asks for answers]

Student 1: "You could say 1/2 of 40 is 20 and 1/2 of 2 is 1 so the answer is 19."

Student 2: "Divide by 2."

T: [stops lesson]: "I'm not going to go on. These are not the answers I wanted."

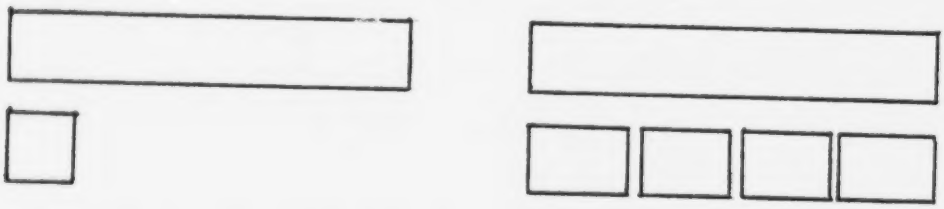
It is difficult to say whether this is an error on the teacher's part, or whether it is a reflection of the teacher's single-mindedness about how a question should be answered. The types of responses given should have promoted classroom discussion about the various ways of saying the same thing in mathematics. The teacher has lost a valuable opportunity to illustrate that

$1/2 \times 64 = 1/2 \text{ of } 64 = 64 \div 2 = 64/2 = 2\overline{)64}$ and

overcome the difficulties that students have in making these associations.

6. Lesson on addition of fractions with different denominators.

T: [writes on chalkboard] 1/8 + 3/4 and then illustrates, using rods, how to add the two fractions



T: moves one block from right (ie. 1/4) to left and says "we have 2/8 on the left now."

It would appear that the teacher is assuming knowledge of the concept he is about to teach.

7. T: (asks question and writes it on chalkboard) "What is 3/4 ÷ 1/2".

Four mathematics lessons were then spent on attempting to teach this concept which had been expressly deleted from the Primary Syllabus in 1980.

8. T: (asks the class the written question): "If a milkman divided 156 bottles of milk between 8 families, how many did each receive?"

Is the desired response 1,1,1,1,1,1,1,149 or

1,1,1,1,1,1,2,148 or .....

or was the student expected to assume the bottles were distributed evenly? If so there remains some milk left. It is left to the student to cry over this split milk question.

9. T: "Our family had travelled 420 km, which was 0.25 of our trip. How far was the trip to be?" So much for placing questions within a realistic framework.

3. Child Activity

a. Attention to able and less-able students.

As this topic features in the recommendations of the Cockcroft Report and is one of the more common criticisms of the N.S.W. mathematics curriculum, the practices of the teachers in relation to what they provided for these groups of students were examined.

In accommodating able students, teachers employed a variety of tactics. The following examples were noted.

1. Extra tasks of the same work and the same standard of work available. This practice was most common if provision was made at all.
2. No preparation for early finishers was made even when some students were actively seeking extra work.
3. Rewarding early finishing by asking the student to write out the "6 times table" (for which no need existed) was noted. This was completed very quickly and the student was told to "sit and wait".
4. A class was given ten minutes for mentals. One clearly capable student finished in five minutes and was praised for sitting with arms folded for the additional five minutes.
5. An able student in another class was used as a messenger and was in charge of video recording for the school.
6. One teacher stated to the observer: "I don't know what to do with him (an early finisher). He won't do extra work and I've been thinking about how I can challenge him." [This comment was made in October which meant the situation had existed for nine months.]

7. Martin, a bright student was observed to sit staring into space, chewing his set square - he appeared to be absolutely bored - while the rest of the class was working on a revision set. This prompts the question as to why all students must spend time on an activity already mastered.
8. Able students, in another class, were set "challenge problems" to solve as well as the task of composing questions for the class bank of challenge problems. Here there were high expectations, held by the teacher, for the able children, who responded well.
9. Early finishers of class work elsewhere attempted other activities from a wide selection of materials kept ready at the front of the class. Keen interest appeared to exist during mathematics lessons with all students being on task.

Generally, few teachers were prepared for students who finished class work early. The majority of teachers presented no extension, either vertical or horizontal, for the able students.

In providing for the less able, fewer illustrative incidents were recorded. The following events were noted, however.

1. Books were collected, presumably for correction and analysis, in one class.
2. Personal attention was given to those who were not coping.
3. One girl, who very clearly was not able to answer a question, was asked for a response.
4. In one class, praise was used very effectively when some less able students performed well.
5. As documented above, in several cases, the less able were required to remain in class to finish activities.

Generally, no allowance was made for the less able members of the class in terms of expectations or method of instruction. It would appear difficult, then, for this group of students, to achieve enjoyment from mathematics. The arrest of the "failure" syndrome which afflicts the less able did not appear to motivate much teacher activity in maths lessons.

b. Attention to task.

As stated elsewhere in this report the frequency of off-task behaviour was low as was the amount of disruption in the class. In cases where students were disruptive or off-task it appeared to be a simple procedure to have them return to the activity they were given. Incidents were noted in several classes where social interaction was sought by students. This interaction was usually achieved by chatting to other students whilst engaging in a work related activity, such as going to sharpen pencils at the front of the room or whilst completing the set work. In many cases the social intercourse was work related. Thus mathematics, at least as far as the students were concerned involved the process of "human interaction". [A small number of the teachers observed appeared threatened by this interaction and appeared to equate "noise" with less work, and hence reacted strongly to curtail these " social processes".]

CONCLUSION

Whilst this study involved a relatively small number of classroom situations, the observations nevertheless provide insights into the way mathematics is taught in these primary schools in N.S.W. The observations demonstrate the hiatus existing between what is taught

and what should be taught (according to the N.S.W. curriculum, to Reports and to experts) and between how it is taught and how it should be taught (according to all the sources, plus sound common sense). It was clear that some teachers were not familiar with either the aims or content of the Curriculum. This points to the need for a greater committment to inservice education especially when changes occur in the curriculum. At the same time it was evident that some teachers were neither confident with, nor competent in, the subject matter thereby adding more weight to the argument for in-service training as well as for more effective pre-service training. Most importantly, it was obvious that teachers had scant knowledge of the components of the learning process; few, for example, knew about the importance of such things as sequencing of subject matter, mastery of prerequisite skills, or of questionning techniques. It is the student who suffers because of these deficiencies in teaching.

The effective teaching of primary mathematics implies an acceptance, on the teacher's part, that concrete aids are essential in developing concepts; that language is an integral part of learning mathematics; that learning is more likely to be retained if it is related to practical situations with which a child can identify and; that children learn at different rates and use different methods to learn. There was scant evidence, if any, of these requirements. A study, such as this, indicates that current practices in Mathematics teaching are quite inadequate. These were well motivated, hard working teachers. Most had been prepared in N.S.W. to teach in N.S.W.

Rather than criticise the teachers, for one would be loath to comment on the inadequacy of individuals when the problem was clearly general, one must criticise the lack of quality in the preparation of them all.

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